



First metatarsophalangeal joint arthrodesis with two orthogonal two hole plates



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ABSTRACT

Objective: First MTP joint fusion is a reliable procedure for advanced arthritis for the first MTP joint. There are many techniques described. The purpose of our study is to report clinical, radiological, functional outcomes and complications of first metatarsophalangeal joint fusion with hand preparation of the joint and fixation with two orthogonal locking plates without a compression screw.

Methods: 32 feet in 26 consecutive patients underwent first metatarsophalangeal joint fusion with above technique. There were 23 women and 3 men. Mean age was 64 years and mean follow-up was 49 months. 21 patients had osteoarthritis, 10 had rheumatoid arthritis and one had psoriatic arthritis. Clinical, radiological, American Orthopaedic Foot and Ankle Score and Foot and Ankle Disability Index clinical rating scales were used for evaluation.

Results: Fusion was achieved in 27 feet. The incidence of radiological non-union was 15.7%. Mean AOFAS score improved from 37.1 to 80.7 ($p < 0.0001$) and mean FADI score improved from 40.3 to 86.9 post-operatively ($p < 0.0001$). Two patients with osteoarthritis and three with Rheumatoid arthritis did not unite. Four of these patients were managed hence revision surgery was not carried out but had low AOFAS and FADI scores. One patient with symptomatic non-union declined further surgery. One patient needed plate removal for a low grade infection and reoperation rate was 3.1%.

Conclusions: In our experience, first metatarsophalangeal joint arthrodesis using two orthogonal two hole plates without a compression screw is associated with a higher non-union rate in our cohort hence we do not recommend this technique.

Level of evidence: Level IV, therapeutic study.

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Introduction

Hallux rigidus is a common condition affecting approximately 2.5% of the adult population.¹ First metatarsophalangeal joint (MTPJ) arthrodesis is a commonly performed procedure for patients who do not respond to non-operative measures. The goals of operative treatment are to improve pain, function, and achieve optimum alignment. There are many techniques described in the

literature to achieve fusion^{2–11} but no single is considered to be exclusive. The technique used depends upon surgeon's preference and available hardware. In general, a four or five hole locking dorsal plate with a compression screw is used commonly. The reported union rates with various techniques vary from 88% to 100%.^{12–14} We conducted a retrospective study of 32 consecutive feet undergoing first metatarsophalangeal fusion with two locking plates placed at right angles without a compression screw. The aim of our study was to report the clinical and radiological outcomes with this technique.

Methods

32 feet in 26 consecutive patients operated between January 2008 and January 2012 for severe hallux rigidus were included in the study. The indication for surgery was intractable pain isolated

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to the 1st MTPJ that was not manageable by non-operative measures. The study was approved by the local ethical committee. Patients with Charcot arthropathy, revision fusion, previous first ray surgery, undergoing simultaneous lesser ray surgery, history of infection in the first MTP joint and severe bone loss were excluded from the study. Table 1 shows patient demographics.

There were 23 females and 3 male patients. 6 patients had bilateral 1st MTPJ arthrodesis as a staged procedure. The mean age at the time of surgery was 64 years (range 40–78 years). The mean duration of follow-up was 49 months (range 40–62 months). There were no patients lost to follow-up. Clinical assessment of the patients was at 2 weeks, 6 weeks, 4 months and 1 year intervals. Follow-up was carried out to determine wound healing, union, functional and radiological outcomes, and metalwork complications. Radiographic union was defined as osseous bridging of 3 out of 4 cortices on AP and lateral radiographs and was assessed by the senior author who was not aware of the AOFAS and FADI scores at the time of radiographic review. Preoperative and postoperative AOFAS Scores (The American Orthopaedic Foot and Ankle Score) and Foot and Ankle Disability Index (FADI) clinical rating scales were used as objective assessments.^{15,16} FADI score was calculated using an online calculator.¹⁷

Statistical analysis

For statistical analysis, online www.graphpad.com statistical software was used. Quantitative variables with normal distribution were expressed as mean \pm standard deviation. Student's paired *t*-test was used to test the hypothesis regarding differences between the variables (AOFAS and FADI scores) pre and post operatively, with 95% confidence intervals.

Operative technique

All patients underwent a standard operative technique and postoperative regimen. The senior author carried out all the operative procedures under general anaesthetic with intravenous antibiotic prophylaxis at induction and a thigh tourniquet at a pressure of 250 mm of Hg. Patient was positioned supine and a medial approach centred over the MTPJ was used. Mid foot block was given. The skin and subcutaneous tissues were dissected as a single layer, and the dorsomedial cutaneous nerve identified and protected throughout the procedure. The capsule was exposed by sharp dissection and a capsulotomy performed in the line of the skin incision to expose the joint and preserved for later repair. Osteophytes were removed and the articular surfaces prepared with bone nibblers, osteotomes and curettes. A 1.6 mm k-wire was used to microfracture the prepared surfaces. Satisfactory alignment was ensured and held with medially and dorsally placed two hole locking plates (TriMed, California, USA) with two locking screws in each plate (Fig. 1). If necessary, the plates were contoured to achieve better conformity to the bone. The capsule was closed with interrupted absorbable sutures, and the skin closed with subcuticular stitches. A gauze and crepe compression dressing was applied at the

conclusion of the surgery. On the tenth postoperative day, wound was checked, dressings reduced and interphalangeal joint mobilisation encouraged. Postoperatively, patients were allowed to heel bear weight in a heel wedge shoe immediately and at six weeks were allowed to bear weight as tolerated in comfortable footwear.

Results

Radiological fusion was achieved in 27 feet. The mean time to radiological union was 94 ± 8 days. 13 out of 32 feet were healed at six weeks, out of remaining 20 feet, 9 were healed at twelve weeks and five at six months. 19 feet out of 21 with a diagnosis of osteoarthritis united radiologically and 7 feet out of 10 in rheumatoid patients united radiologically. There were five radiological non-unions (Fig. 2).

Mean preoperative AOFAS score of 37.1 (range 22–54) improved to 80.7 (range 38–88) postoperatively ($p < 0.0001$). Mean preoperative FADI score was 40.3 (range 18.3–61.2) and improved to 86.9 (range 28.4–100) postoperatively ($p < 0.0001$). Pre- and postoperative measurements for the AOFAS and FADI scores are presented in Table 2. The mean post-operative AOFAS and FADI scores in patients with non-unions was 57 (range 38–66) and 59 (range 28–72) respectively.

Three non-unions were in patients with rheumatoid arthritis who were on Methotrexate and anti-TNF treatment. The remaining two non-unions were in otherwise fit and healthy individuals but one was a heavy smoker. Out of the five radiological non-unions, four were managing hence did not wish to proceed to revision fusion though had low functional scores. One younger patient who was a heavy smoker did not achieve clinical or radiological union and was symptomatic, revision surgery was offered with counseling for cessation of smoking but the patient declined due to personal circumstances. One patient with rheumatoid arthritis developed a low grade wound infection that was treated with antibiotics and metal work removal following radiological fusion. The reoperation rate was therefore 3.1%.

Discussion

First metatarsophalangeal joint fusion is a reliable procedure for the treatment of advanced hallux rigidus that does not respond to non-operative measures. There are many techniques described in the literature to achieve fusion. In our series, we observed an overall radiological union rate of 84.3%. The radiological non-union rate of 15.7% is higher than that reported in the literature^{12,18–22} ranging from 8% to 14%. The non-union in the rheumatoid group was 30% and in the osteoarthritis group was 10%. Four out of five radiological non-unions in our cohort were managing and revision surgery was not undertaken in these cases. One patient who was clinically symptomatic declined revision surgery. One patient had a low grade infection that did not respond to antibiotics, local wound care, rest and elevation needed plate removal. The reoperation rate was 3.1% which is lower as compared to 4%–18.7%^{12,14,21,23}; reported in the literature.

Three cases with a diagnosis of Rheumatoid Arthritis who did not progress to union were on methotrexate and anti-TNF treatment. One patient with non-union in the osteoarthritis was heavy smoker. Four patients with non-unions in our study were low demand and were managing though with a low AOFAS and FADI scores. These patients were counselled and an informed decision not to undertake revision fusion surgery was made. There was one case of low grade wound infection that was treated with antibiotics and removal of plates when radiologically united. Mean post-operative AOFAS score reported using a single dorsal plate¹² and a hybrid locking plate with a plantar neutralization screw²⁴ have demonstrated postoperative AOFAS scores less than 80 and in our

Table 1
Patient demographics.

Age	Mean 64 years (40–78)
Osteoarthritis	21
Rheumatoid Arthritis	10
Psoriatic Arthritis	1
Smokers	3
Diabetic	0
Tourniquet Time	84 mins (66–98)



Fig. 1. Pre and Post-operative radiographs showing fusion of the first metatarsophalangeal joint. (A) Preoperative radiographs, (B) Post operative radiographs showing fusion of first MTP joint.



Fig. 2. Radiographs showing non-union.

Table 2
Summary of AOFAS and FADI scores (scores \pm standard deviation).

Score	Preop	Postop	Change
AOFAS	37.1 \pm 8.8	80.7 \pm 8.8	43.6 (p < 0.0001)
FADI	40.3 \pm 11.0	86.9 \pm 14.2	46.6 (p < 0.0001)

study was 80.7 however patients with non-unions had a low post-operative AOFAS and FADI scores in our study.

The main advantage of the plates used in our study is their low profile hence considered to be less irritant to soft tissues which is a concern around the big toe. The incidence of plate removal was low but we experienced a higher non-union rate than reported in the literature. Early weight bearing ambulation in immediate post-operative period was allowed encouraging early rehabilitation and promoting patient convenience but radiological union rate in our series is lower than reported in a retrospective review of immediate weight bearing after first MTPJ fusion.¹⁹

Plate fixation is technically less challenging compared to other methods of first metatarsophalangeal fixation and is a recommended technique²⁵ but disadvantages include higher cost, soft tissue irritation, larger exposure and need for plate removal in some cases. We believe that the higher non-union rate in our study could be explained by the rigid fixation achieved by these plates due to proximal and distal locking screws contributed by patient biology to a certain extent and perhaps the biomechanics of this fixation technique are not stable enough to promote union. It may be possible to reduce the non-union rate with addition of a compression screw. The results of our study demonstrate that first MTPJ fusion with two orthogonally place two hole plates without a compression screw has a higher non-union rate than reported in the literature. Most of the patients with non-unions were managing and re operation rate was low but a higher non-union rate is a concern.

Limitations of our study include heterogeneous group of patients, small cohort and a single surgeon series with patients being followed up in his clinic and as such intra-observer errors or bias cannot be ignored.

Conclusion

We conclude that first metatarsophalangeal joint arthrodesis using medial and dorsal locking plates without a compression screw is a simple technique but has a higher non-union rate that is a concern hence do not recommend this technique.

Conflicts of interest

Nil.

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Nil.

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